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I, JULIE BILLINGSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2004903507 for a patent by CTECH CLOSURES PTY LTD as filed on 29 June 2004.

WITNESS my hand this
Twelfth day of August 2004

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Extensive art exists for tamper evident closures and corresponding container necks for example US Patents 4,807,771 (Roy) and 4,653,657 (Papavasilopolous). 5,660,288 Nyman

Problems exist with prior art including loss of seal between closure and container prior to tamper evidence features operating and

poor visibility of status of tamper evidence such that a consumer may not discern that a container has been opened.

Tamper evident band design on most closures includes an interference between the container neck and the tamper band. Often upon opening and removal of the closure the tamper evident band does not drop away from the closure body but remains by means of interference between the tamper evidence band and the container neck held on the neck in a similar position to the tamper band on an un-opened package or in the case of malicious tampering a container may be opened and contaminants introduced and the closure replaced and the tamper evidence band pushed back into close proximity to the closure to give the appearance of an un-opened package.

The present invention will address one or more of the defects and or introduce one or more improvements in prior art.

The present invention is a neck for a container and closures and a tamper evident closure system of tamper evident closures and co-operating container neck.

The following examples and descriptions are non-limiting.

Fig. 1 is a side view of the container neck 60 having
- One or more threads 67 including multi start threads which co-operate with corresponding threads on a closure and
- an annular tamper bead 62 which may be segmented and if segmented then one or more segments being ramped similar to 66C and having angled engagement face similar to the features 66A depending from the lower surface of the said segment and
- one or more ramped projections 66 in close proximity to the lower surface of the said annular tamper bead with
- angled engagement faces 66A having
  - a width 'J' which is similar to or less than the distance that the tamper bead 62 projects beyond the outside wall 64 of the container neck and

is designed to interact with engagement portion 58 on closure 10 (refer Fig. 2) such that the engagement portion 58 which consists of more than one separate elements 58
(shown in Fig. 2B before being folded into the engagement position in Fig. 2) upon removal rotation and as the leading edge of the engagement elements 58 engages with the angled engagement faces 66A of container neck ramped projections 66 then

upon further removal rotation the engagement elements 58 are driven downwards along angled face 66A placing axial stress on and hastening the severance of the frangible bridges 50 thus promoting early tamper evidence operation and opening a discernable gap between the closure body and the tamper evident band.
It should be noted that this system has the advantage over much prior art in that if the tamper band is pushed back to position in close proximity to the closure body to mimic the appearance of an un-opened package then upon re-opening of the package the previous opening and severing of connection between tamper band and closure will be revealed in that the tamper band will not rotate and will not be visibly driven downwards on opening thus enabling to consumer to more easily discern that the package has previously been opened.

faces 66C which preferably present a ramped surface to minimise interference and enable the engagement portions 58 to pass easily over the projections upon application of the closure to the neck. However, because the closure can be designed to be applied by axial movement (for example using multiple thread) rather than rotational or so designed that application rotation finishes almost simultaneously with the free end 59 (refer figs.2 , 2A, 2B & 5) of engagement portion 58 passing over container tamper bead 62 then faces 66C need not be ramped.

faces 66B which are of a dimension 'K' which at least exceeds the width of the space 58C (Fig. 2) between the engagement portions 58 of the tamper band 55 so that the free ends 59 engagement portions 58 will be retained below the edge 66M of the projection 66 thereby making a more visible gap between the severed tamper band 55 and the closure skirt 30

Fig. 2 is a partial cross section of a tamper evident closure 10 (shown partially) having
a top wall 20 and depending from it
an annular sealing device 40 sealingly engaging the inside wall 65 of the container neck 60 and
another annular sealing device 41 which may also but not necessarily be used to sealingly engage with either or both the upper wall 63 and the outer wall 64 of the container neck 60 (shown not fully sealingly engaged) and
a skirt 30 with threads which threadingly engage with threads on the container neck to apply and remove said closure in the case of closures applied by rotational movement and to remove closures applied by axial movement and
depending from said skirt
frangible bridges 50 connecting tamper evidence means 55

The design of the closure following the formula being (when the closure is fully applied)
the distance 'A' (in this example being the distance over which an interference fit and seal continues to occur between the annular sealing device 40 and the inner wall 65 of the container neck 60 during removal of the closure from the fully applied position (not shown) on the container neck and further described as being the distance between line A1 [being the line touching the top wall 63 of the container neck] and the line A2 [being the line touching point of sealing engagement between annular sealing device 40 and the inner wall 65 of the container neck 60 measured at the point when the closure is fully applied(not shown) to the container neck (in an alternative sealing method the formula may take the distance 'A' to represent the distance shown in Fig. 2A between line A3 and the line A4 being the distance over which an interference fit and seal continues to occur between the annular sealing means 44 and the outer wall 64of the container neck 60 during removal of the closure from the fully applied position)
shall be always sufficiently larger than
the distance 'B' (being the distance between the engagement surface 61 of the tamper bead 62 and the engagement surface 59 of the tamper ring engagement means 58 when the closure is fully applied to the container)

plus a distance 'C' (not shown) equaling the amount of compression that occurs in the said tamper ring engagement means during the process of removal
plus a distance 'D' (not shown) equaling the amount of stretch that occurs under stress during closure removal in the said skirt and said frangible bridges connecting the tamper evidence annular ring 55 to the closure skirt 30
plus a distance 'E' (not shown) being the distance equal to the tolerance allowed in the measurement specifications of the container neck 60 and the closure 10
plus as may be required a distance for margin of safety for a particular closure and neck combination

so as to promote upon removal rotation of the closure the operation of the tamper evident means prior to loss of the seal between closure and container neck.

Fig.3 is a cross section of the ramped projection 66

Fig.4 is a cross section of the container neck showing the preferred location of ramped projections 66 (shown below tamper bead 62 –annular dotted line) and we disclose a method of manufacture and mould assembly to make the said container necks as follows.

The line 'V' 'V' is the parting line of 2 mould portions but as shown by the line 'V1' 'V1' in Fig1. the mould part line may advantageously follow the path dictated by the boundary between faces 66A and 66B so that the ramped faces 66A may be formed in the projections 66-2 and 66-4.

Angle 'F' is preferably 90 degrees or less.

In a 2 piece mould and

considering a section through the part of the container mould forming the neck and projections 66 with the parting line being the straight line from 90degrees to 270 degrees (3 o'clock to 9 o'clock) 0 degrees being at 12 o'clock then

considering that we nominally divide the said section into 4 equal quadrants 1 and 2 both being in the mould 1st half and quadrants 3 and 4 being in the mould 2nd half .
Quadrant 1 270 to 360 degrees and
Quadrant 2 0 to 90 degrees and
Quadrant 3 90 to 180 degrees and
Quadrant 4 180 to 270 degrees both then

only in Quadrants 1 and 3 or at the juncture between them and Quadrants 2 and 4 may faces 66A be formed with angle 'F' at 90 degrees or less.
Projections 66 moulded with face 66A formed in Quadrant 1 from 270 to about 359 degrees (the difference between 359 and 360 degrees is an allowance for "draw" to enable the mould to open without interference with at least the faces 66A) may have faces with angle 'F' decreasing from 90 degrees by 1 degree for every degree less than 359 degrees and similarly in Quadrant 3 from 179 degrees.

Having angle 'F' less than 90 degrees is advantageous in that the free edges 59 59A of engagement portions 58 upon removal rotation of the closure and contact with faces 66A will tend to be urged inwards across faces 66A towards the neck wall 64 and thereby to remain in close proximity to faces 66A and the container neck wall 64 tending to ensure continued movement downwards along face 66A.

However if projections 66 are moulded with at least the surface of faces 66A formed by the mould in quadrants 2 and 4 (other than at the juncture with quadrants 1 and 3) faces 66A will have angles 'F' greater than 90 degrees which will upon removal rotation of the closure have the undesirable effect of tending to direct the free edges 59 59A of engagement portions 58 away from container wall 64 and past projection 66.

It should be noted that the mould parting line may deviate (from a centerline where one mould half is a mirror of the other) to accommodate the forming of 1 or 2 of projections 66 thus one half of the mould may project across the "mirror image parting line" into the space normally occupied by the second mould half and the said second mould half will have a corresponding shape to accommodate the projecting 1st half.

In removal operation of most commonly used single thread closures from a container approximately at least the first 90 degrees of removal rotation does not lift the closure in the direction of removal because there is firstly an amount of dimensional tolerance difference between the co-operating threads on container and closure.

One example of the present invention container neck preferably has 4 of projections 66 located equidistant or substantially equidistant so that within approximately the first 90 to 120 degrees of closure removal rotation most of the free ends 59 & 59A of engagement portions contact the said projections and are urged downwards along faces 66A thereby placing axial stress on and substantially or completely severing the majority frangible bridges and moving the tamper band 55 below the lower surface 66M of projection 66 providing an early and more visible tamper evidence.

Another example of the present invention container neck preferably has 2 or more of projections 66 located in Quadrants 1 and 3 such that all projections 66 have an angle 'F' less than 90 degrees. or substantially equidistant so that within approximately the first 90 degrees of closure removal rotation most of the free ends 59 & 59A of engagement portions contact the said projections and are urged downwards along faces 66A thereby severing the majority frangible bridges and moving the tamper band 55 below the lower surface 66M of projection 66 providing an early and more visible tamper evidence.

The parting line 'V1' 'V1' in Fig. 1 may vary from that shown and still achieve the forming of the said ramped projections.

The container mould may also be of the expanding core type with more than 2 segments which will allow moulding of at least one of projections 66 in each segment of an expanding core mould.

Fig. 5 is a partial cross section of an alternate tamper evidence band 55 having

frangible bridges 50connecting the said tamper evidence band to the closure (not shown)

tamper bead engagement means 58 having engagement surfaces 59 and 59A . In one example (not shown) said engagement surfaces 59A have an angle corresponding to angled faces 66A so that engagement surfaces 59A tend to make contact with faces 66A over a greater portion of said engagement surface 59A and tending to avoid the curling or folding of the junction of surface 59 and 59A thereby assisting in directing engagement surface 59A downwards along angled faces 66A.

one or more perforations 58B at the hinge point or line 53 shaped and positioned so as to allow drainage of any product spillage during the filling process

one or more recesses 58A in the free end of the said tamper bead engagement means 58 said recesses having widths 'R' and depths 'S'. The depth 'S' is preferably such that during application of the closure to the container that the hoop strength existing in the continuous annular portion of the band along line extending from the bases 58E of recess 58A is sufficiently reduced and is less than for a band without recesses 58A. Thus segments 59D are able to flex along the line extending from the bases 58E of recess 58A to facilitate a more easy application of the closure to the container.

one or more segments 59D extending between recesses 58A

In closure removal operation the width 'R' and depth 'S' of one or more recess 58A is such that upon removal rotation

the depth 'S' ideally being greater than the distance between dotted lines W and X (Fig. 1)

thereby allowing the free end 59 of segments 59D at least when adjacent to angled engagement faces 66A to remain in close proximity to the container neck and

allow the free end of closure engagement surfaces 59A to engage angled engagement faces 66A (refer Figs. 1,3,4) and

as removal rotation continues said free end of engagement surfaces 59A are driven downwards along angled engagement faces 66A promoting axial stress upon and breakage of frangible bridges 50 promoting early separation of said tamper band 55 from closure 10 and

the continuous annular portion of the engagement portions 58 of the tamper band 55 along the line extending from the bases 58E of recess 58A enhances the effectiveness of contact between said engagement surfaces 59A and said angled engagement faces 66A by assisting to maintain the location of engagement surface 59A (for example the present band will have enhanced performance in this aspect when compared to a tamper band that has engagement portions 58 consisting of discrete segments as shown in fig. 2B)

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Said recesses 58A may have differing widths and depths and engagement surfaces .

In closure application operation the ramped upper shoulder of container tamper bead 62 urges tamper bead engagement portion 58 of tamper band 55 against the inside wall of said tamper band so that the tamper band may pass over the said tamper bead and the ramped surfaces 66C of projections 66 urge the free edges of the upper regions of engagement portions 58 against the inside wall of said tamper band so that the said engagement portions of the tamper band may pass over the said projections 66.
In another example of closure tamper band at least 4 of the recesses 58A referred to as location recesses may have dimension 'R' increased in size and located so that upon full application to the container neck the center point of each said location recess is approximately adjacent the center of each of the similar number (being 4 in this example) of projections 66 such that the engagement surfaces 59 have clearance from either side of at least faces 66B of projections 66. In the same example at least 4 other recesses 58A are smaller in 'R' dimension than the said location recesses and ideally smaller in 'R' dimension than the length of that portion of lower face 66M which adjoins face 66B of projections 66 thus ensuring. Upon removal rotation engagement surfaces 59 contact the said projections 66 and are urged downwards along faces 66A thereby placing axial stress sequentially on and substantially or completely severing at least the majority of frangible bridges 50 and moving the tamper band 55 below the lower surface 66M of projections 66. Recesses 58A other than the said location recesses being of less in dimension 'R' will pass under those portions of lower face 66M which adjoins face 66B of projections 66 thus continuing the sequential axial stressing and substantial severing of frangible bridges 50 and separation of the tamper band 55 from closure 10 thus promoting early and more visible contemporaneous evidence of opening.

The tamper bands 55 referred to herein may be of less height than prior art and or the gap (refer Fig. 1) between the lower surface 66M of projection 66 and the point at which the wall 64 of the container neck becomes further from the axis of the container (e.g. at a support ring) may be increased to provide space below the tamper band to accommodate deflection of the said tamper band downwards during removal of the closure and create a more easily visible gap between the closure and the separated tamper band. The relative location and spacing of each of engagement surfaces 59A or each of the leading edge upon removal rotation of engagement portions 58 may be advantageously arranged such that one of the said engagement surfaces or leading edge of engagement portions either simultaneously (thereby reducing the likelihood of the band skewing to one side) or in a sequential manner (thereby reducing the force required at any one

moment to break frangible bridges) , contacts each of the angled engagement faces 68A so as to promote a more effective and or easy removal of the tamper band from the closure

The closure inventions herein or part or parts thereof are designed to be manufactured using the mould equipment and method as disclosed in US patents 6,551,093 and 6,640,988 –inventor Taha which are hereby incorporated in this application but modified at least in that the engagement portion of the tamper band 58 is moulded in a position such that (referring to Fig. 5) the angle 'A' between line A1 extended from and parallel to the inside wall of the tamper band 55 and line A2 extended from and parallel to the outside wall of the annular engagement portion 58 of the tamper band is greater than 0 degrees and less than 45 degrees and preferably 30 degrees.

The present inventions also extend in a non limiting manner to any one or more of the foregoing aspects combined with one or more of the following:-

various child resistant features one of which may be of the type whereby it is necessary to exert downward force either on the top of the closure or on the top of an over-cap which fits over the top of the closure, such that the downward force overcomes resistance thereby allowing engagement means between the over-cap and the closure to enable removal rotation of the closure to operate the tamper evident feature and remove the closure from the neck of the container.

The concept of moulding the closure from more than one type of material. For example it would assist recycling if the closure tamper ring was moulded in the same material as the container.

Various dispensing means such as, but not limited to, a perforated or partially perforated closure with flip top cover, a flexible membrane with cruciform or other pattern slits or openings to thereby permit the dispensing of container contents or a pump action dispenser or a push/pull valve closing/ opening feature.

A closure applied by axial rather than rotational motion and closures with more than one thread means.

A closure with cooperating ratchet or engagement means between the skirt of the closure and the tamper ring such that co-operation between the said engagement means or any of them on the skirt and the tamper ring tends to prevent rotational force on the tamper ring during application from severing the frangible bridges connecting the tamper ring to the skirt of the closure.

Various means of employing an additional foil seal to ensure freshness of the contents of a container and which may include a means to pierce the foil.

Closures made of metal or plastic or metal and plastic combined as may be useful in hot fill vacuum seal packages.

Containers of plastic, metal and glass .

Persons skilled in the art may adopt alternate versions of this closure system and container neck without departing from the present invention.

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